DOOSAN Document Transmittal

Upper Trishuli-1 HEP (216MW)

Date	DT No.:	SHEET
2022-06-06	UT1-HEP-DHI-PC-D-0033	1 OF 1

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SUBJECT	Submission of Review Note RN-0132, RN-0133 and RN-0134		

S. N.	REVIEW NOTE NO.	REVIEW STATUS	DWG. / DOC. NO.	REV.	DWG. TITLE / DOC. DESCRIPTION	REMARK
1	RN-0132	AN	UT1-C-090-CVL-DG-64002	0B	Excavation and Initial Support Drawings of Main Access Tunnel to Powerhouse	
2	RN-0133	AN	UT1-C-300-CVL-DC-60001	0B	Stability Calculations for the Surrounding Rock of Powerhouse Cavern	
3	RN-0134	RR	UT1-C-845-CVL-DG-70002	0A	Monitoring Layout Drawing of Underground Powerhouse and Transformer Cavern	
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Legend of Review Status
A : APPROVED
AN : APPROVED AS NOTED
RR : RETURN FOR RESUBMISSION
FI : FOR INFORMATION

DHI STAMP

Doosan Heavy Industries & Construction Co. Ltd. Branch Office Nepal
DOOSAN

Issued by DHI

for

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Doosan Heavy Industries & Construction Co., Ltd.

Discipline : Civil

UPPER TRISHULI-1 HEP (216MW)			
Client	**Nepal Water and Energy Development Company Private Limited**		
Owner's Engineer	**Tractebel Engineering GmbH / Jade Consult**		
REVIEW NOTE			
Contractor	**Doosan Enerbility**		
Title of the Document	Stability Calculations for the Surrounding Rock of Powerhouse Cavern		
Document No.	UT1-C-300-CVL-DC-60001	Revision	0B
Date of Documents	27.05.2022	Received Date	27.05.2022
Transmittal Form No.	UT1-HEP-DHI-D-0245		
Previous Review Date/Status	26.05.2022/RR	Prev. Review Note No.	RN-0130
Review Note No.	**RN-0133**	**Present Review Date**	**05.06.2022**
		Present Review Status	**AN**
A: Approved AN: Approved as Noted RR: Returned for Resubmission FI: For Information, only			

General Comments

The concept of the design calculations and the results are – in general - accepted. However, there are several items, which still need to be quantified so that the calculations results can be appropriately used and verified during the construction of the Powerhouse and the Transformer Hall.

The results obtained with the FE-calculations are essential when monitoring the actual performance of rock mass during cavern excavation and comparing it to the results of the model.

In this context the monitoring system suggested in the (**to be revised**) document No. UT1-C-845-CVL-DG-70002 shall be used and all monitoring items shall be selected (=extensometers and optical targets). The FE-model shall provide "predicted" monitoring results, which need to be confirmed during construction. **Both** relevant monitoring sections (Section 1 and 2/3) of document No. UT1-C-845-CVL-DG-70002 shall be addressed and expected monitoring results need to be quantified. This means that the FE-calculations need to be conducted for both sections.

To use FE-model results successfully the following needs to be done:

- The geometry of the FE-mesh needs be adjusted that it fits also to Section 1 of the monitoring drawing No. UT1-C-845-CVL-DG-70002 (currently it fits to Section 2/3, only).
- The FE-model needs to be refined where the respective extensometers are located. The Crown Section needs to be separated into the Central Section and the Side Drifts.
- The monitoring points in document No. UT1-C-845-CVL-DG-70002 (extensometer points and optical targets) need to be defined in the FE-model and the same designation as in the monitoring drawing shall be used.
- The same applies to selected bolts and dowels for determining the development of stresses in the rock reinforcement.
- The calculations and respective evaluation of (expected monitoring) data shall be conducted for both sections, Section 1 and Section 2/3 of document No. UT1-C-845-CVL-DG-70002.

Such procedure is mandatory as it will make the results of the FE-calculations useful for construction. With such data one can define for construction:

- Rock mass behaviour as expected, displacements/reinforcement stresses as predicted (green level)

- Increased displacements/reinforcement stresses (yellow level)
- Alarming displacements/reinforcement stresses (red level)

This is necessary as base of an "alarm plan" and the definition of respective engineering actions, all to be defined in the Method Statement for the construction of the Powerhouse and Transformer Hall.

Wedge Analyses (prismatic wedges)

The prismatic wedge in the cavern roof, as shown in the figure below has been assumed to be a truncated pyramid, which is principally correct.

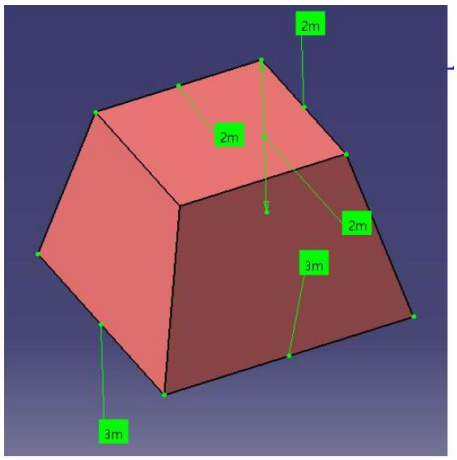

Figure 7-6 Potential prismatic wedge in the cavern roof

However, the geometry of this prismatic wedge was assumed to be 2 x 2 x 3 m without any justification. The geological data provided in the Annex of the calculation report in hand allow to better define the size (and weight) of such wedge. The geological data shall be evaluated (orientation and spacing of discontinuities) to more realistically define the wedge geometry.

It shall also be determining for which thickness (height of truncated pyramid) the installed capacity of reinforcement is producing the required safety factor of 2.0.

The pre-stressing force of rock dowels in the cavern roof needs also to be clearly defined and justified. This is to show that this pre-stressing force (if so) holds wedges already in place with the safety factor of 2.0.

DISCLAIMER

Any approval will not release the Contractor from any of his obligations under the Contract.

Dr. U. Glawe